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(71) Applicant *(for all designated States except US)*: METAL MANUFACTURES LIMITED [AU/AU]; Level 33, Gateway, 1 Macquarie Place, Sydney, NSW 2000 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: TINDALL, Glenn, Andrew [AU/AU]; 31/17–25 Elizabeth Street, North Parramatta, NSW 2151 (AU).

(74) Agent: SHELSTON WATERS; 60 Margaret Street, Sydney, NSW 2000 (AU).

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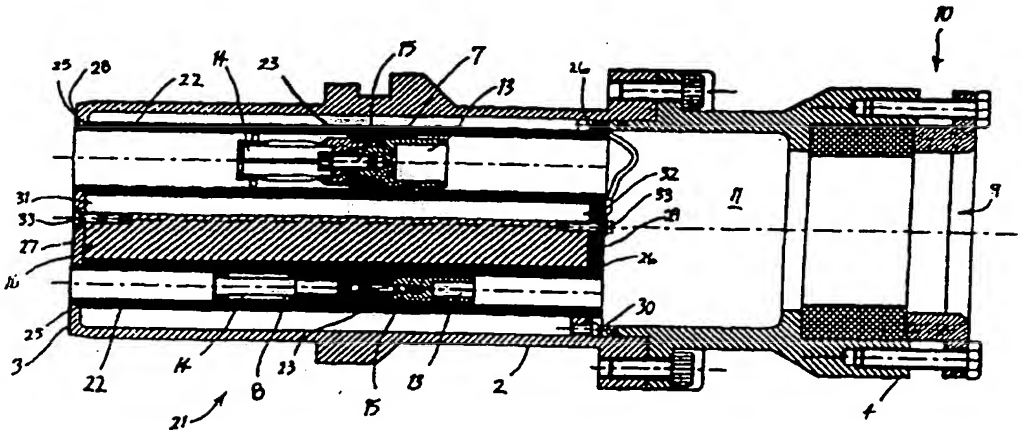
(54) Title: ELECTRICAL PLUG



(57) Abstract

An electrical plug (21) includes six equally angularly spaced axially extending tubular insulators (22) which have a central internal annular ridge (23) against which a thimble (13) and a socket (14) are collectively secured by the operation of bolt (15). A phase barrier (16) is a structural member being engaged at opposed ends (31, 32) by respective plates (27, 29). The plates are forced toward each other and into clamping engagement with insulators (22) by the action of bolts (33) which are threadedly engaged within complimentary bores in barrier (16).

TITLE: **ELECTRICAL PLUG**

TECHNICAL FIELD

The present invention relates to an electrical plug.

The invention has been primarily developed for medium to high voltage and/or medium to high current multi-core power supply cables such as those used in the underground mining industry and will be described hereinafter with reference to that application. However, it will be appreciated that the invention is not limited to that particular field of use.

Known electrical plugs for power supply cables used in underground mines have generally included an axially extending cylindrical body which is configured at one end for insertion into a complimentary receptacle having a number of connector pins. The other end of the body is configured to receive a multi-core cable. Within the body the ends of the cable cores are electrically connected to respective internal contacts which, in turn, selectively electrically engage with the connector pins within the receptacle.

As it is necessary to insulate the ends of the various cores in the multi-core cable from each other the body generally includes a one piece moulded insulator which surrounds the internal contacts and allows them to contact only a respective connector pin. An example of a known electrical plug is illustrated in Figures 1 and 2 and will be described below in more detail.

The known plugs are particularly disadvantageous as they are heavy and the insulator is prone to damage and is difficult to replace without at the same time replacing all the internals of the body. In a mine environment where operating

In a preferred form, the or each tubular insulator is cylindrical. Alternatively, the or each insulator has a square cross section.

Preferably, in circumstances where a plurality of insulators are used they are equally angularly spaced within the cavity.

Preferably also, the or each insulator is surrounded by a respective additional tubular insulator. More preferably, the or each insulator is separated from the additional insulator by an air gap.

In a preferred form the connectors are disposed wholly within the respective tubular insulators.

According to another aspect of the invention there is provided an electrical plug including:

a body extending between a first end and a second end which are respectively configured for engagement with a complementary electrical plug and receiving an electrical cable having one or more cores;

one or more connectors for receiving at respective first ends the one or more cores and at respective second ends a connector formation associated with the complementary plug to allow releasable electrical connection between the cores and the connector formations; and

one or more insulating sheaths extending about respective ones of the one or more connectors for electrically isolating the connectors from each other.

Preferably, the connectors are metallic and the sheaths are plastics sleeves. In other embodiments the sheaths are defined by a layer of ceramic material which is deposited on the outside of the connector.

(not shown) and receiving a multi-core electrical cable (not shown). As is well known to those in the art, multi-core cables generally include three equally spaced apart medium or high voltage mains conductors and one or more pilot cores for carrying communication signals. Body 2 includes a single piece moulded interior insulator 5 which extends from end 3 and terminates at end 6, which lies intermediate ends 3 and 4. Insulator 5 surrounds two differently sized sets of three connectors 7 and 8 which, at one end, receive the cores of the cable and, at the other end, receive the connector pins that are located within the receptacle. Accordingly, electrical connection is selectively provided between the cores in the cable and the connector pins within the receptacle. One such receptacle is described and illustrated in Australian Patent Application No. 21600/95, the disclosure of which is incorporated herein by way of cross reference.

The end of the cable is received in an aperture 9 at end 4 of body 2 and subsequently secured by clamping means 10. The cores of the cable are separated in internal chamber 11 and inserted into respective cylindrical bores 12 in insulators 5 and secured to connectors 7 or 8, as appropriate.

Connectors 7 and 8 each include at one end a thimble 13 for receiving the free end of a respective cable core, as is known to those skilled in the art. The end of the core is soldered or otherwise connected to thimble 13. Each connector also includes, at its other end, a socket 14 for receiving a respective connector pin located within the receptacle. That is, the connector pins are received into engagement with respective sockets 14 when plug 1 is inserted into the receptacle. The respective pairs of thimble 13 and contact 14 are maintained in abutting electrical engagement by bolts 15.

inwardly extends from end 3. Plate 27 includes a plurality of apertures which receive the ends of insulator 22, whereby plate 27 abuts against shoulder 25.

At the other end of insulators 22, the complementary formation is defined by a circular plate 29 which includes apertures corresponding to those in plate 27. These apertures in plate 27 interact similarly with shoulders 26 of the insulators.

Both plates 27 and 29 are secured to body 2 by way of circumferentially spaced rivets 30. Moreover, these plates are structural members and provide additional strength to plug 21 and, accordingly, increase the useful lifetime of the product. Moreover, plug 21 provides this additional strength while being lighter than the prior art plug 1.

In this embodiment barrier 16 is also a structural member being engaged at opposed ends 31 and 32 by respective plates 27 and 29. The plates are forced toward each other and into clamping engagement with insulators 22 by the action of bolts 33 which are threadedly engaged within complimentary bores in barrier 16.

In other embodiments only the cores in the cable carrying supply voltages are within insulators 22, the pilot lines being of sufficiently low voltage that the intermediate air gap is adequate to prevent arcing therebetween.

In some embodiments, once the cable is installed within cavity 11, that cavity is filled with an expandable compound via a filling aperture (not shown). The compound stress relieves the cable termination and reduces the possibility of water ingress from outside the cable and plug, or through water entrapment within the cable (a function of the cable manufacturing process).

passages through which sheaths 45 extend. In this embodiment cone 46 is both metallic and earthed. Accordingly, cone 46 functions not only as a mechanical support for plug 41 but also as a phase barrier.

Cone 46 includes, at one end, shoulders 48 which extend across the periphery of the adjacent passages to provide an abutment for one end of sheaths 45. Cone 46 also includes, at its other end, a removable end cap 49 which also extends across the periphery of the passages to provide an abutment for the other ends of sheaths 45. The combination of shoulders 48 and cap 49 captively retains sheaths 45 within cone 46.

In this embodiment, cap 49 is retained to cone 46 by a bolt 50 which is offset from the passages. In other embodiments different attachment means are used.

Body 2 includes a hollow cylindrical housing 51 which extends along axis 47 between a first end 52 and a second end 53 which are respectively threaded internally and externally. End 52 also includes an abutment formation 55 for receiving a coupling nut 56. Moreover, cone 46 includes an abutment formation 57 and an external thread 58. When thread 58 is engaged with end 52, as shown in Figure 6, nut 56 is captively retained between formations 55 and 57 for rotation about axis 47. Nut 56 includes an internal thread 59 for selectively engaging with a complementary thread of the electrical plug or receptacle.

End 53 is received within the complementary internally threaded end 65 of a backnut 66. Sandwiched between end 53 and backnut 66 is a rubber grommet 67 and a washer 68. As will be appreciated by those skilled in the art, as the threaded engagement between backnut 66 and end 53 is increased, grommet 67 is compressed

insulation between the cores at a weight significantly less than corresponding prior art plugs. By way of example, plug 21 is approximately 20% lighter than prior art plug 1.

Although the invention has been described with reference to a particular example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

8. A plug according to claim 1 including a plurality of insulators which are equally angularly spaced within the cavity.

9. A plug according to claim 1 wherein the or each insulator is surrounded by a respective additional tubular insulator.

10. A plug according to claim 9 wherein the or each insulator is separated from the additional insulator by an air gap.

11. A plug according to claim 1 wherein the connectors are disposed wholly within the respective tubular insulators.

12. An electrical plug including:

a body extending between a first end and a second end which are respectively configured for engagement with a complementary electrical plug and receiving an electrical cable having one or more cores;

one or more connectors for receiving at respective first ends the one or more cores and at respective second ends a connector formation associated with the complementary plug to allow releasable electrical connection between the cores and the connector formations; and

one or more insulating sheaths extending about respective ones of the one or more connectors for electrically isolating the connectors from each other.

13. A plug according to claim 12 wherein the connectors are metallic.

14. A plug according to claim 12 or claim 13 wherein the sheaths are plastics sleeves. 15. A plug according to claim 12 or claim 13 wherein the sheaths are defined by a layer of ceramic material which is deposited on the outside of the connector.

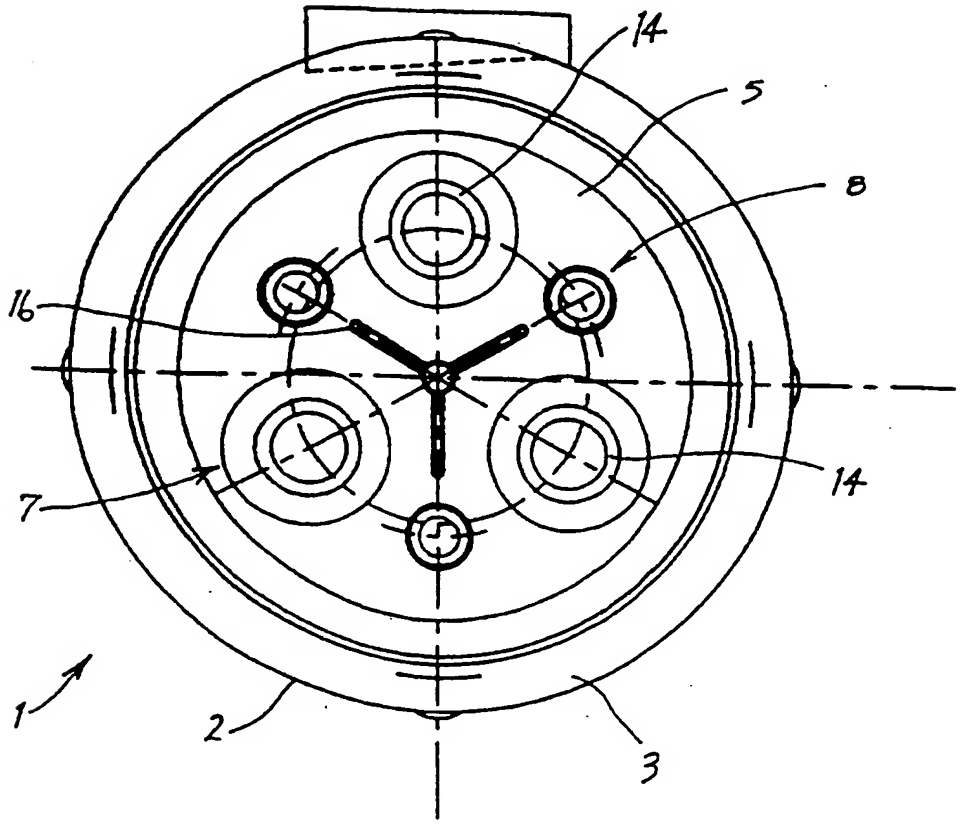


FIG. 1

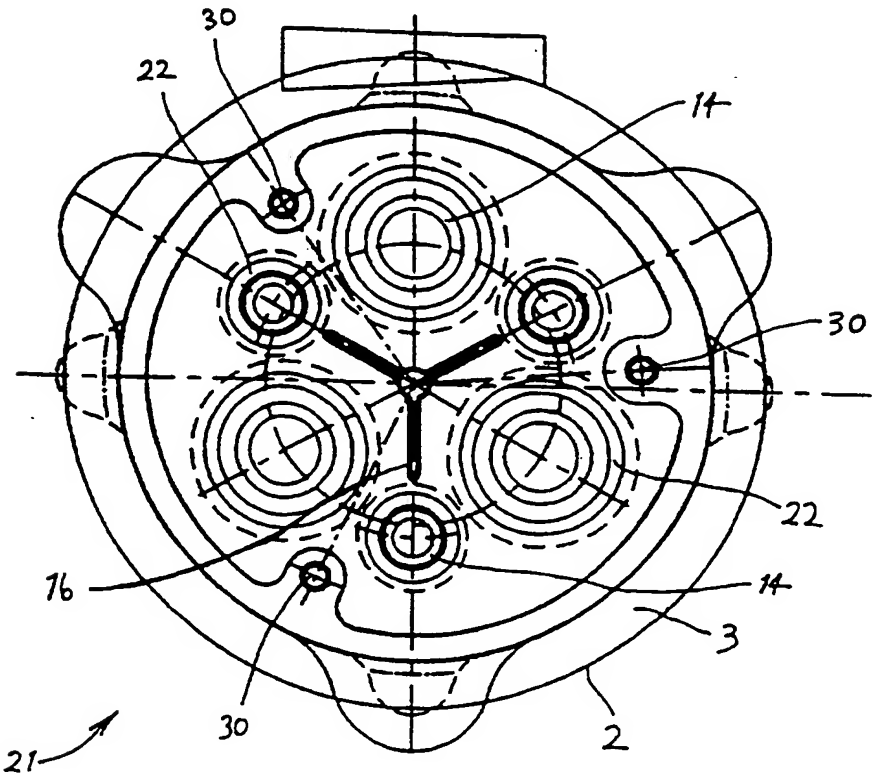


FIG. 3

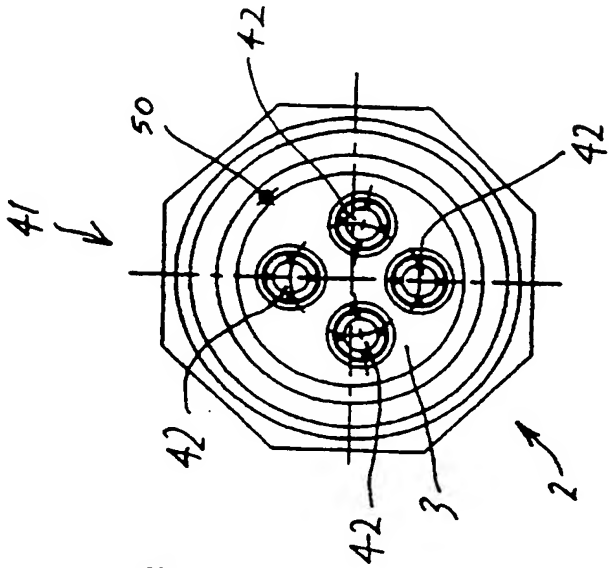


FIG. 5

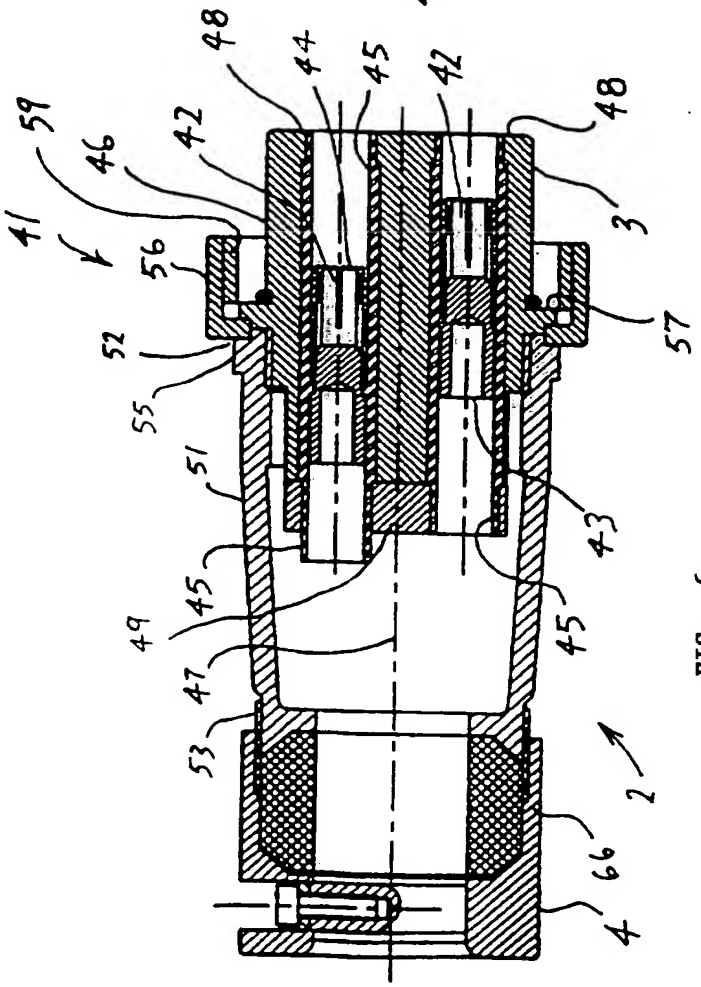


FIG. 6

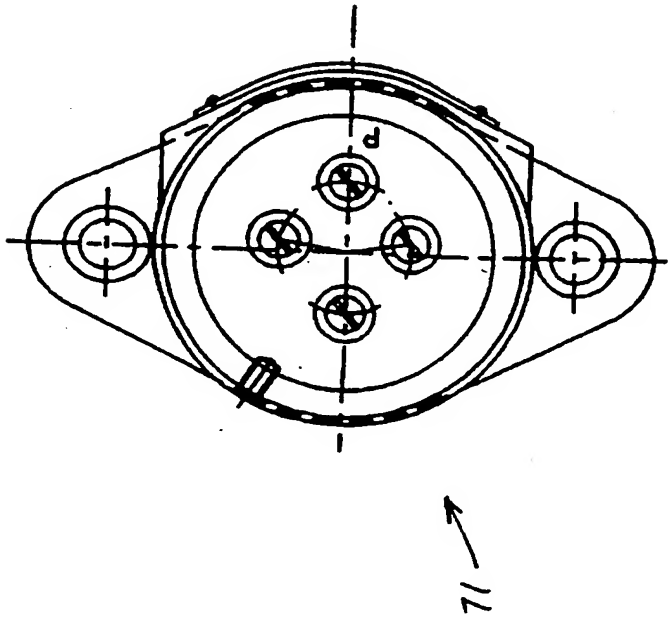


FIG. 8

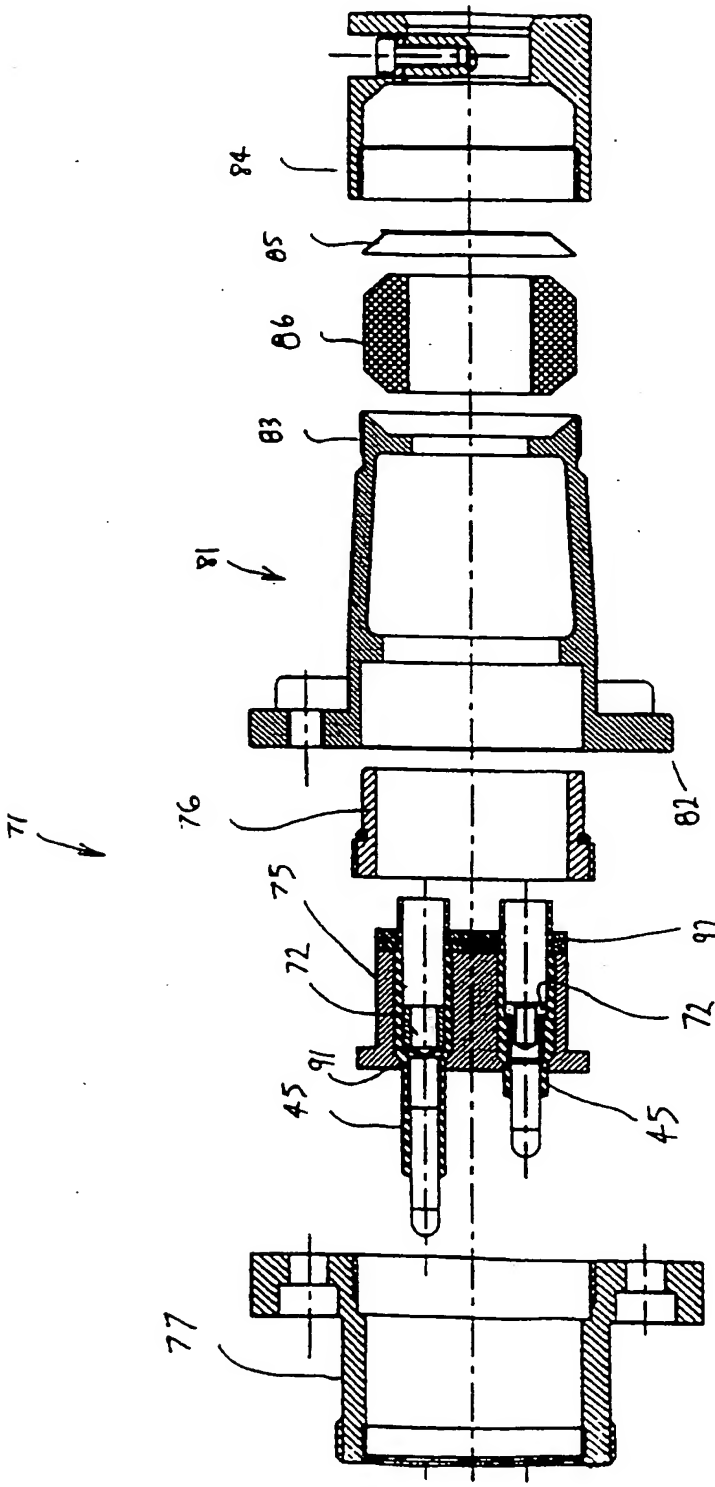


FIG. 11

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00651

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 18228/88 A (MACEY MINING SERVICES PTY LTD) 12 January 1989 Figure 16, Page 7 lines 22 to 27, Page 8 lines 3 to 6	1,6,8,11 to 14 16 to 19
Y		15
X	GB 2206460 A (GEWERKSCHAFT EISENHUTTE WESTFALIA GmbH) 5 January 1989 Page 6 lines 13 to 15, Page 7 lines 12 to 25, Page 8 lines 5 to 7	1,6,12
X	GB 2029129 A (REYNOLDS INDUSTRIES INC) 12 March 1980 Whole document and the figures	1,6,9,10,12
Y	Page 2 lines 60 to 62	15
X	GB 2077523 A (ITT INDUSTRIES INC) 16 December 1981 Page 2 lines 18 to 34	1,6,7,12 to 14